Geophysical Research Abstracts
Vol. 12, EGU2010-2760, 2010
EGU General Assembly 2010

End-Member modelling and quantification of terrigenous flux rates to the NW African continental margin during the late Pleistocene to Holocene

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The region off Gambia is an interesting study area because of its geographical location in between the ITCZ summer and winter position. We study a sediment core spanning the last 60 kyrs off the Gambia river mouth (W Africa) to identify different sources of the terrigenous sediment components exported to the continental margin. Our aim is the quantification of terrigenous flux rates of fluvial and aeolian load, respectively to improve our understanding of palaeoclimatic conditions and climatic changes in the Sahel and Sahara. It is known that in western Africa arid conditions prevailed during glacials and North Atlantic Heinrich Events. After the Last Glacial Maximum (LGM) a humid climate dominated northern Africa between 5-12 kyrs BP, known as the African Humid Period (AHP). These climatic changes have already been documented in magnetic, chemical, mineralogical and sedimentological proxies, respectively. However, these investigations were mainly carried out in qualitative approaches and lack an integrated multi-proxy validation.

We apply a multi-proxy approach using XRF-element data and environmental magnetic parameter analysis on 5 cm interval samples of sediment core GeoB13602-1 (13°32.71 N; 17°50.96 W). Carbonate and biogenic opal content were analysed to estimate the total terrigenous fraction. Environmental magnetic parameters including ARM, IRM, HIRM, SIRM and frequency-dependent susceptibility allow the estimation of magnetic minerals, e.g. magnetite, hematite and goethite. Ratios of these parameters reflect grainsizes of the magnetic minerals which are indicative of transport mechanisms. We performed an End-Member (EM) analysis of IRM acquisition curves, decomposing the bulk sample into different components which represent individual sediment sources. Our approach is to include chemical, sedimentological and magnetic parameters in this EM model to reconstruct the composition as well as the transport pathways of the sediments. Based on an age model, which will be derived from an oxygen isotope curve, we can calculate separate accumulation rates for aeolian dust, fluvial and biogenic components.

A preliminary four-component model based on rock magnetic parameters shows best results because the EMs have different signatures. Downcore, the contributions of the EMs are highly alternating. EM1 represents a dust source which is dominant during the LGM. The magnetic parameters indicate that EM1 contains a high amount of hematite which is also visible in the colour and core description data. The contribution of EM2 is very low within the LGM and high during the interval attributed to the AHP. From the magnetic signature we can say that it contains a relatively high proportion of high-coercive magnetic minerals (goethite, hematite) as well as magnetite. The signature of EM3 indicates that it mainly contains a magnetite fraction which is typical for fluvial sediments. It is dominant during the time following the AHP; during the AHP and the LGM it is tributary. We suggest that EM2 and EM3 represent fluvial sources. Their alternating dominance indicates that the composition of the fluvial load is variable with time. We can clearly identify EM4 as a relict magnetic facies due to the reduction of iron oxides.